DOES POLICY ENHANCE COLLABORATIVE-OPPORTUNISTIC BEHAVIORS? LOOKING INTO THE INTELLECTUAL CAPITAL DYNAMICS OF SUBSIDIZED INDUSTRY-UNIVERSITY PARTNERSHIPS

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ABSTRACT

Design/methodology/approach: By combining two sources of information about 683 Mexican subsidised industry-university partnerships from 2009 to 2016, this study adopted the structural equation modelling (SEM) to analyse the effect of collaborative vs. opportunistic behaviours in intellectual capital dynamics within subsidised projects.

Purpose: Little is known about how subsidies enhance both collaborative and opportunistic behaviours within subsidised industry-university partnerships, and how partners' behaviours influence the intellectual capital dynamics within subsidised industry-university. Based on these theoretical foundations, this study expects to understand IC's contribution as a dynamic or systemic process (inputs→outputs→outcomes) within subsided university-industry partnerships. Especially to contribute to these ongoing academic debates, this paper analyses how collaborative and opportunistic behaviours within industry-university partnerships influence the intellectual capital dynamics (inputs, outputs, and outcomes) of the subsidised projects.

Findings: Our results show three tendencies about the bright/dark side of subsidies within the Mexican industry-university partnerships. The first tendency shows how collaborative behaviours positively influence intellectual capital dynamics within subsidised industry-university partnerships. The second tendency shows how opportunistic behaviours influence intellectual capital impacts (performance) and return to society (job creation). The third tendency shows how initial inputs of subsidised projects generate some expected socio-economic returns that pursued the subsidies (mediation effect of intellectual capital outputs).

Research limitations/implications: This research has three limitations that provide a future research agenda. The main limitations were associated with our sources of information. The first limitation, we did not match subsidised partnerships (focus group) and non-subsidised partnerships (control group). A qualitative analysis should help understand the effect of subsidies on intellectual capital and partnerships' behaviours. The second limitation, our measures of collaborative/opportunistic behaviours as well as intellectual capital dynamics should be improved by balancing traditional and new metrics in future research. The third limitation is that in emerging economies, the quality of institutions could influence the submission/selection of subsidies and generate negative externalities. Future research should control by geographical dispersion and co-location of subsidies.

Practical implications: *For enterprise managers*, this study offers insights into IC dynamics and behaviours within subsidised industry-university partnerships. The bright side of collaboration behaviours is related to IC's positive impacts on performance and socio-economic returns. The dark side is the IC appropriation behind opportunistic behaviours. Enterprise managers should recognise the relevance of IC management to capture value and reduce costs associated with opportunistic behaviours. *For the university community*, this study offers potential trends adopted by industry-university partnerships to reinforce universities' innovative transformation processes. Specifically, these trends are related to the legitimisation of the university's role in society and contribution to regional development through industry-university partnerships' outcomes. Therefore, university managers should recognise the IC benefits/challenges behind industry-university partnerships.

Social implications: *For policymakers*, the study indirectly shows the role of subsidies for generating/reinforcing intellectual capital outcomes within subsidised industry-university partnerships. The bright side allows evaluating the cost-benefit of this government intervention and the returns to priority industries. The dark side allows for understanding the need for implementing mechanisms to control opportunistic behaviours within subsidised partnerships. Accordingly, policymakers should understand the IC opportunity-costs related to industry-university partnerships for achieving the subsidies' aims.

Originality/value: This study contributes to three ongoing academic debates in innovation and management fields. The first debate about how intellectual capital dynamic is stimulated and transferred through the collaborative behaviour within industry-university partnerships in emerging economies. The second debate is about the “dark side” of partnerships stimulated by public programmes in emerging economies. The third debate is about the effectiveness of subsidies on intellectual capital activities/outcomes.

KEYWORDS: Intellectual Capital; Subsidies; Industry-university Partnerships; Collaborative-Opportunistic behaviours; Emerging economies

1. INTRODUCTION

Over the last three decades, researchers have paid great attention to intellectual capital (IC) as the primary source for sustainable competitive advantages (Roos and Ross, 1997; Dabić et al., 2021). Specifically, extant studies have associated this complex concept with organizations’ intangible components and creating wealth (Stewart, 1997; Ponzi, 2002; Manzari et al., 2012; Ullberg et al., 2021). Intellectual capital embraces intangible resources and capabilities to create value-added (Stewart, 1997; Kianto et al., 2017). Although IC is strongly related to the appropriation of capabilities, competencies, and experiences that pursue long-term competitive advantages (Yitmen, 2011), the accumulated literature shows the lack of an explicit focus on IC and innovation partnerships (Ponzi, 2002; Manzari et al., 2012; Cuozzo et al., 2017). The IC’s antecedents and consequences are strongly related to the following three ongoing academic debates.

The first academic debate has highlighted the need for IC and innovation studies (Ponzi, 2002; Manzari et al., 2012; Cuozzo et al., 2017). Although industry-university partnerships are effective sources of intellectual capital and value-creation, the lack of studies is associated with the non-existence of measures capturing traditional intellectual capital metrics through official datasets or via the information generated by subsidised university-industry partnerships. IC’s accumulated literature has shown the need for consensus in metrics and categories (Cuozzo et al., 2017). In this regard, Dumay (2009) and Dumay and Edvinsson (2013) have recommended adopting a critical approach for measuring intellectual capital, given its complexity and difficulty. Similarly, the link between innovation and the intellectual capital dynamics (inputs→outputs→outcomes) remains under-researched (Perkmann and Walsh, 2007; Senge and Forrester, 1980). Previous studies have shown the positive effect of intellectual capital among networks on performance and competitiveness (Solitander and Tidström, 2010; Kamukama et al., 2011; Bontis et al., 2018). However, little is known about the dynamic transformation process of intellectual capital. In this assumption, intellectual capital represents a dynamic component that involves the transformation process of several IC inputs (human capital, relational, organizational…) into the expected intellectual capital outputs (products, services). Subsequently, the value-creation of these intellectual capital outputs will produce multiple IC outcomes/returns to organisations (performance, competitiveness) and society (wealth, employment).

The second academic debate has justified R&D subsidies with the idea of market failures (i.e., financial constraints, uncertainties, risk aversion, and dynamic externalities) that further reduce private R&D investment (Nelson, 1959; Arrow, 1962; Choi and Lee, 2017). According to Clarysse et al. (2009, p. 1517), market failures are caused by leakages and spill-overs, which prevent the private sector that undertakes innovative activities from fully capturing the benefits of their investments. In this view, as ventures are not incentivized to invest, the government should intervene to compensate the private underinvestment through different policy instruments to promote intellectual capital and innovation (García-Quevedo, 2004; Clarysse et al. 2009; Edler and James, 2015; Dimos and Pugh, 2016; Kochenkova et al., 2016; Torres-Bareto et al., 2016). Specifically, in emerging economies, subsidies have gained pre-eminence in public policy and have been the central topic in the competitiveness agenda of the Inter-American Development Bank, the World Bank, and the Organization of American States (Hall and Maffioli, 2008). It explains why policymakers have instituted industry-university partnerships through subsidies as a strategy to stimulate innovation, intellectual capital, and economic development (Cohen et al., 2002; Mahmood and Rufin, 2005; Takalo and Tanayama, 2010; Guo and Guo, 2011; Guerrero and Urbano, 2016). We assume that R&D subsidies/incentives oriented to industrial-university partnerships (Perkmann and Walsh, 2007; Guerrero et al., 2019a; Serino et al., 2020) are relevant antecedents of intellectual capital components. Although the market failure theory justifies R&D subsidies, the major concern is that the theory is not very clear on whether the government can identify R&D projects that are subject to market failure (Choi and Lee, 2017, p. 1465), as well as the imperfection of resource allocations (Love, 1995, p. 399).

The third academic debate has questioned the effectiveness of subsidies to industry-university partnerships (Zeng et al., 2010; Kovacs et al., 2015), especially in emerging economies (Hall et al., 2016; Beltramino et al., 2021). Extant studies have explained that market resource allocation for R&D subsidies is not socially optimal because information asymmetry and opportunism make information in markets imperfect (Arrow, 1962). Transaction cost theorists have generally neglected to consider the implications that there is an invisible hand of the market mechanism for the risk of opportunism (Hill, 1990). Institutional economic theorists have associated this effect with the lack of institutions' quality (Guerrero et al., 2019a, b). Assuming that the government does not have the mechanism to identify behaviours within subsidised projects, opportunistic behaviour could appear when subsidies are perceived as the perfect substitute of the financial contribution that one or more partners should provide within a research project (Wallsten, 2000; Baldwin and Robert-Nicoud, 2007). Previous studies have associated this effect to crowding-out effects that allow stopping to spend funds during the subsidised years of a project because subsidies are enough to continue ongoing the planned R&D activities (Dimos and Pugh, 2016). In this sense, the crowding out effect may come from innovation strategies based on external funds for developing R&D activities (Fölster, 1995; Irwin and Klenow, 1996). These practices encompass moral hazard problems when one partner attempts to be more competitive, appropriating its partners' resources/capabilities for its benefit (Frishammar et al., 2015). Simultaneously, opportunistic partners take advantage of market failures, weak institutions, and asymmetries of information for obtaining resources/funds from several public programmes and external partners (Conner and Prahalad, 1996). Therefore, little is known about how subsidies enhance both collaborative and opportunistic behaviours within subsidised industry-university partnerships (Gianiodis et al., 2016; Guerrero et al., 2019a), and how partners' behaviours influence the intellectual capital dynamics within subsidised industry-university (Pedro et al., 2018; Sanchez et al., 2009).

Inspired by these two academic debates, this paper analyses how collaborative and opportunistic behaviours within industry-university partnerships influence the subsidised project's intellectual capital dynamics (inputs, outputs, and outcomes). Theoretically, we proposed a conceptual model tested in an emerging economy (Mexico). We selected this emerging economy for two reasons: (a) from 2009 to 2016, the Mexican administrations have been implemented subsidies to reinforce intellectual capital, innovation, and knowledge transfer through industry-university partnerships (OECD, 2013), and (b) Mexican ventures and universities have adopted open innovation practices to share costs, risk and intellectual capitals (Guerrero and Urbano, 2016). Empirically, we designed a two-step mixed methodology. In the first step, we tested our model using data from 683 Mexican subsidised industry-university partnerships by Incentive Program for Innovation from CONACYT (Clarysse et al., 2009). In the second step, we analyse the effect of behaviours in intellectual capital dynamics (Pedro et al., 2018; Sanchez et al., 2009).

The paper is organized as follows: in section 2, we propose our conceptual framework; in section 3, we describe the methodological design used in this paper; in section 4, we show and discuss our findings; and in section 5, we show the main conclusions of the study, the implications for various stakeholders, and research agenda.

2. SUBSIDIES, BEHAVIORS, AND INTELLECTUAL CAPITAL DYNAMICS

2.1. Theoretical foundations

In a recent literature review (Manzari et al., 2012, p. 2257), IC is considered as an intangible asset that is closely related to intellectual materials (knowledge, experiences, expertise, property) that are appropriated through internal or external collaborative innovation processes to offer better opportunities for an organization to succeed in social and economic terms. In this study, IC is understood as intangible capabilities, competencies, and experiences used by organisations or partnerships to create/transfer knowledge, wealth, or value-added (Stewart, 1997; Edvinsson, 2002; Ponzi, 2002; Kianto et al., 2017; Ullberg et al., 2021). By adopting a subsided industry-university perspective, IC inputs are related to the appropriateness of capabilities, competencies, and experiences as a result of routines, flows of information, or knowledge transfer processes among partners (Carayannis et al., 2017; Del Giudice et al., 2013; Scuotto et al., 2017; Serino et al., 2020).

Industry-university partnerships are effective sources of intellectual capital and value-creation within innovation processes (Perkmann and Walsh, 2007; Cuozzo et al., 2017). In this sense, the intellectual capital dynamics represents a dynamic process (inputs→outputs→outcomes) in which the intellectual capital inputs contributed by industry-university partners (competencies, capabilities, and expertise) will be transformed into innovation outputs (products, services, and process) and technology transfer outputs (patents, utility models), then will generate value-added to partnership (performance) and returns to society (spillover effects and employment).

However, as individuals integrate industry-university partnerships, the intellectual capital dynamics (inputs→outputs→outcomes) will be positively/negatively influence their behaviours (Das et al., 2003; Guerrero et al., 2019b). According to Williamson (1975), opportunistic behaviours are responsible for the organisational failure and constitute a lack of honesty within cooperation/collaboration (Williamson, 1987; Hill, 1990; Wilding and Humphries, 2006; Lui et al., 2009). Specifically, opportunist behaviours also affect the operational effectiveness and intellectual capital dynamics by the multiple controls implemented to reduce them (Das and Teng, 2001; Brachos et al., 2007; Kovacs et al., 2015; Dezi et al., 2019b; Guerrero et al., 2019b).

Based on these theoretical foundations, this study expects to understand IC's contribution as a dynamic or systemic process (inputs→outputs→outcomes) within subsided university-industry partnerships.

2.2. Hypotheses

Subsidies allow industry-university partners access to public funds with a relatively lower cost than other alternative funding sources (Aschhoff, 2009; Aschhoff and Sofka, 2009). In this view, subsidies engage open innovation practices, reduce fixed-costs and increase the probability of achieving the R&D goals (Chesbrough, 2003; Chesbrough et al., 2018; Nieto and Santamaría, 2007; Benavente et al., 2007; Guerrero and Urbano, 2016). A recent meta-regression analysis has evaluated the effects of subsidies on industry-university partnerships (Dimos and Pugh, 2016). This meta-analysis also helps to understand the intellectual capital dynamics and collaborative/opportunistic behaviours within subsidised university-industry (Baldwin and Robert-Nicoud, 2007; Wallsten, 2000).

Collaborative behaviours represent an opportunity for sharing intangible elements like know-how, competencies, capabilities for achieving the R&D goals (Carayannis et al., 2000; Whitley, 2002; Zeng et al., 2010; Guerrero and Urbano, 2019b). Based on crowding-out and additionality effects theoretical foundations, the collaborative rationality considers subsidy as additional financial support instead of substituting partners' investments (Dimos and Pugh, 2016). In this rationality, collaborative behaviours within industry-university reduce costs because based on trust, partners share their intellectual capital inputs that will ensure the expected intellectual capital outputs (Buisseret et al., 1995; Autio et al., 2008; Clarysse et al., 2009). It produces a signalling effect about the quality of the project/team, the absence of information asymmetries, and the flow of intellectual capital among partners (Lerner, 1999). In contrast, opportunistic behaviours represent an opportunity to appropriate partners' intellectual capital while the subsidised projects are continuing ongoing (Dimos and Pugh, 2016). As a result, opportunistic behaviours generate biased intellectual capital inputs and outputs among the university-industry partners (Fölster, 1995; Irwin and Klenow, 1996; Chen et al., 2002). It happens when opportunistic partners reduce failure/risks by substituting their investment or intellectual capital contributions through other private/public funds (Sutz, 2000; Klerkx and Aarts, 2013; Torres-Bareto et al., 2016)

By assuming the existence of partners' behaviours within subsided university-industry partnerships, we assume that opportunistic behaviours will be more successful in the flow of intellectual capital inputs (expertise, capabilities, competencies, know-how) required in R&D projects, and consequently, these projects will be more likely to obtain better intellectual capital outputs (innovation and technological results) than collaborative partners. We assume that opportunistic partners will take advantage of market failures, weak institutions, and asymmetries of information to appropriate partners' intellectual capital inputs (Conner and Prahalad, 1996). Therefore, collaborative parents will be more likely to share their intellectual capital with their partners and looking for public funds for ensuring the project's success. Intuitively, the partnership may capture more intellectual capital to ensure the success of its projects. Based on these arguments, we propose the following hypothesis (inputs→outputs).

> *H1a: Intellectual capital inputs (expertise, capabilities, competencies) have a positive effect in the R&D project to achieving the expected intellectual capital outputs (innovation and technology).*
> *H1b: University-Industry partners' behaviours moderate the positive flow of intellectual capital inputs (expertise, capabilities, competencies) needed in the R&D project to achieving the expected intellectual capital outputs (innovation and technology).*

The public funds' intrinsic purpose is to generate positive returns for university-industry partnerships (innovation performance) and society (generation of employment) (Belderbos et al., 2004). We assume that the intellectual capital flow among subsidised university-industry partnerships (intellectual capital inputs) transformed into innovations and technologies (intellectual capital outputs) help to achieve partnership's performance as well as to generate returns to society (intellectual capital outcomes). Previous studies have shown that the university-industry partnership's performance is related to the capture of value-added through revenues (Trigo and Vence, 2012) and retribution of using public funds through job creation and spillover effects (Hill, 1990; Bogers, 2011; Salmi, 2012).

We assume that collaborative behaviours will generate more positive effects on intellectual capital outcomes than opportunistic behaviours (Li and Kozhikode, 2009; Dimos and Pugh, 2016). The plausible explanation is that the reasoning of collaborative behaviour is producing intellectual capital sharing effects to generate benefits for society (Bogers, 2011). In contrast, opportunistic behaviours are based on moral hazard problems that generate instability and transactional costs (Williamson, 1987; Sutz, 2000; Klerkx and Aarts, 2013; Bäck and Kohtamäki, 2015; Torres-Bareto et al., 2016). Instability and costs outweigh the outcomes generated by intellectual capital within the collaboration (Hottenrott and Lopes-Bento, 2016). At the partnership level, opportunistic behaviours will produce positive intellectual capital outcomes in the short-term, but the associated opportunistic-costs will reduce the long-term positive effects (Söderblom and Samuelsson, 2013). At the societal level, the opportunistic partnership's economic return to society will be more limited and lower than collaborative partnerships. Based on these arguments, we propose the following hypothesis (outputs→outcomes).

> *H2a: Intellectual capital outputs (innovation and technology) has a positive effect on the partnership (innovation performance) and the society (generation of employment or industrial spillovers)*
> *H2a: University-Industry partners' behaviours moderate the positive returns of intellectual capital outputs (innovation and technology) into the partnership (innovation performance) and the society (generation of employment or industrial spillovers)*

Neither theoretically nor empirically, there are a few insights about the effectiveness of subsidies in stimulating intellectual capital and resulting in significant intellectual capital outcomes (Clarysse et al., 2009; Greco et al., 2016; Hall et al., 2016). By assuming the intellectual capital dynamics view (inputs→outputs→outcomes), we argue that the intellectual capital inputs (experience, capabilities, competencies) shared among the subsided university-industry partnership have contributed to achieving intellectual capital outcomes (performance and society returns) through the generation of intellectual capital outputs (innovations and technologies) (Solitander and Tidström, 2010; Kamukama et al., 2011; Bontis et al., 2018).

In this sense, proponents of subsidies justify the importance of subsidies that promote the flow of intellectual capital among university-industry partnerships (García-Quevedo, 2004; Dimos and Pugh, 2016). In contrast, opponents of subsidies could argue asymmetries of information (Callahan et al., 2012) or opportunistic behaviours (Sissoko, 2011; Hall et al., 2016) among university-partnerships and governments. In this regard, it is possible to identify the effectiveness of subsidies exploring the mediation effect of intellectual capital outputs on the relationship between intellectual capital inputs and intellectual capital outcomes (Obeidat et al., 2017).

By assuming a mediation effect, it is possible to identify the direct and indirect contribution to the subsidy's intellectual capital outcomes via intellectual capital inputs and intellectual capital outputs. Therefore, this insight is aligned with the primary purpose of the subsidy that is impacting intellectual capital results (products, services, process, patents, licenses) by generating a better venture performance (sales, exports, revenues) and good returns to the society (job creation, spillovers). The absorptive capacity of intellectual capital among collaborative modes is strongly related to organizational outcomes (Bontis et al., 2018; Santoro et al., 2018) and productive outcomes in the region (Kamukama et al., 2011; Nicotra et al., 2018). Based on these arguments, we propose the following hypothesis (inputs→outputs→outcomes).

> *H3a: Intellectual capital outputs (innovation and technology) has a positive mediating effect on the flow of intellectual capital inputs (expertise, capabilities, competencies) needed to achieve the R&D expected intellectual capital outcomes (innovation performance, social returns)*
> *H3b: University-Industry partners' behaviours moderate the positive mediating effect that exerts intellectual capital outputs (innovation and technology) into the flow of intellectual capital inputs (expertise, capabilities, competencies) needed to achieve the R&D expected intellectual capital outcomes (innovation performance, social returns)*

Figure 1 summarizes the conceptual proposed model.

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3. METHODOLOGY

3.1. The Mexican Incentive Programme for Innovation

The Mexican government enacted the Science and Technology Law to foster scientific research, technological development, and innovation in 2002. The National Council for Science and Technology (CONACYT) is the main body responsible for defining, developing, and implementing the law (Diario Oficial, 2014). From 2009 to 2016, Mexico implemented the Incentive Programme for Innovation with an investment of 2932 million dollars (Guerrero et al., 2019a, 2019b) that support innovative ventures registered at the National Register of Institutions and Scientific and Technological Ventures (RENIECYT). In this vein, the projects' submitters were Mexican ventures on behalf of the industry-university partnership.

The Incentive Programme for Innovation programme aims to encourage growth, competitiveness, linking enterprise and scientific organizations to incorporate specialized human capital, generate innovations with value-added to strategic sectors, and contribute to the creation/protection of intellectual property. In particular, the innovation programme included three modalities: INNOVAPYME oriented to promote projects developed by SMEs both individually or in collaboration with universities/research centres; INNOVATEC oriented to promote projects developed by large ventures both individually or/and in collaboration with a university/research centre, and PROINNOVA oriented to promote projects developed in collaboration with at least two universities or two research centres. Therefore, our analysis unit was the subsided projects submitted by Mexican ventures in collaboration with Mexican universities (industry-university partnerships).

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3.2 Data collection

The empirical analysis uses an original, unexploited, and novel dataset combining two sources of information collected by CONACYT from 2009 to 2016 related to the Incentive Programme for an Innovation programme.

The first source was the intellectual inputs dataset. The CONACYT collected this data during the submission process of the three public modalities (INNOVAPYME, INNOVATEC, and PROINNOVA) of the Incentive Programme for Innovation programme. The dataset contained information[1] about 3817 subsided applications and 9451 non-subsided applications (Table I). In this regards, the study focused on subsided partnerships because this dataset provides additional information about ventures (size, sector, sub-sector, location), the collaborations with scientific and commercial organizations, the individual subsidies, and the investment per application (total amount, % reported by private sources – investment per partner-, % reported by public sources – subsidy-).

The second source was the intellectual outputs/outcomes dataset. The CONACYT collected this data at the end of the subsided projects. The dataset provides information about intellectual capital outputs in terms of innovation in products, services, processes, patents, licenses, dissertations, as well as intellectual capital outcomes in terms of sales, reduction of costs, revenues, job creation, and trained employees. The information was collected through a survey at different stages of the project – pre, during, and post-. By reviewing the partners' IDs, we identified a panel of 683 Mexican ventures related to 2140 subsidies projects in our period of analysis. It means that Mexican ventures submitted more than one project on behalf of the subsided partnership (industry-university) during the analysis period. Therefore, we used the accumulative and lagged amounts per subsided partnership.

3.2.1 Description of variables

Our metrics are based on considering IC as a dynamic process (inputs→outputs→outcomes) and not static. Any intellectual capital needs to be transformed into outputs and outcomes. Inside organisations or partnerships, the sharing and flow of intellectual capital are converted into tangible elements (products, services, diversification practices, and others) that will impact performance. This study only translated this reasoning into the analysed phenomenon. Table II summarizes the set of variables included in the analysis.

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Partnership behaviours were measured using a dummy variable that takes value 1 when the subsidised venture showed an opportunistic behaviour, and value 0 when the subsidised venture showed a collaborative behaviour. By following Dimos and Pugh's (2016) meta-analysis, we identified diverse effects related to subsidies' effectiveness. Concretely, we reviewed the contribution of each venture to each subsidised project. An opportunistic behaviour was observed when the subsidised partners contribute less than the total amount indicated in the submitted proposal. It represents that the subsidised partners financed the projects using external money from subsidies or partners (Osterloh and Frey, 2000; Söderblom et al., 2015; Dimos and Pugh, 2016). A collaborative behaviour was identified when the partner financed the total amount indicated in the initial proposal. This behaviour is intrinsically

[1] Information included the ID application, the application year, description of projects, modality of the public programme, general characteristics about the partnership (venture and university or research centres). However, by confidential agreements, we faced restrictive access to specific details to identify industrial partner. Based on this limitation, an analysis with the follow-up and the matching of non-subsidized partner with subsidized partners were not possible.

motivated by looking for public funds to set up the subsidised partnership (Aerts and Schmidt, 2008; Clarysse et al., 2009; Dimos and Pugh, 2016).

Intellectual capital inputs were measured using a set of three variables. First, the capabilities measured by the number of collaborations with (scientific t_0 and commercial t_0) partners, as suggested by Belderbos et al. (2004). Second, experience regarding the scale and time of previous collaborations (Guerrero et al., 2019a, 2019b). Third, competencies measured by the number of venture's trained employees enrolled in subsidised collaborations (Busom and Fernandez Ribas, 2008). Being involved in multiple collaborations with scientific or commercial parents/agents brings researchers the know-how, competencies, capabilities, and learning that could be considered part of the human intellect (e.g., a more specialized human capital). As many collaborators and involved in multiple projects, the intangibles or know-how will be higher and creativity emerges for generating value (Bellini et al., 2019; Schwartz et al., 2012; Ullberg et al., 2021). Indeed, previous studies have measured human capital through the experience captured in the number of years and linking them with success (Unger et al., 2011). Therefore, we assume that a subsidized university-industry partnership requires experience in managing them. More concretely, if the partner has been enrolled in many subsidized projects for a long time, the partner gains the experience, know-how, and relational capital required in R&D projects (Schwartz et al., 2012).

Intellectual capital outputs were measured using a set of six types of innovation and technology transfer results (Torres-Barreto et al., 2016; Guerrero et al., 2019a, 2019b). First, the number of new products obtained at the end of the project concerning the expected products indicated in the initial proposal (new products t_n-t_0). Second, the number of new services obtained at the end of the project concerning the expected services indicated in the initial proposal (new services t_n-t_0). Third, the number of new processes obtained at the end of the project concerning the initial proposal's expected process (new processes t_n-t_0). Four, the number of new patents obtained at the end of the project concerning the expected patents indicated in the initial proposal (new patents t_n-t_0). Five, the number of utility models obtained at the end of the project concerning the expected utility models indicated in the initial proposal (new utility models t_n-t_0). Six, the number of dissertations obtained at the end of the project concerning the number of dissertations indicated in the initial proposal (new dissertations t_n-t_0). Previous IC studies have measured intellectual capital's effects on innovations using product/process innovation scales (Elsetouhi et al., 2015; Subramaniam and Youndt, 2005). In this study, we use objective measures that capture the number of innovations and technologies in the context of university-industry partnerships (Torres-Barreto et al., 2016; Guerrero et al., 2019a, 2019b).

Intellectual capital outcomes were measured using a set of six outcomes based on previous studies (Audretsch and Feldman 1996; García-Quevedo, 2004; Söderblom et al., 2015; Dimos and Pugh, 2016; Hottenrott and Lopes-Bento, 2016; Bellucci et al., 2018). First, the natural logarithm of sales generated at the end of the project respect the expected sales indicated in the proposal (LnSales t_n-t_0). Second, the natural logarithm of revenues generated at the end of the project concerning the expected revenues indicated in the proposal (LnRevenues t_n-t_0). Third, the natural logarithm of exports generated at the end of the project concerning the expected exports indicated in the proposal (LnExports t_n-t_0). Four, the number of new projects in diversified sectors concerning the sector indicated in the proposal (Spillover t_n-t_0). Five, the number of jobs generated at the end of the project respects the expected job indicated in the proposal (Employment t_n-t_0). Finally, several control variables are used to analyse the investment per partner, the number of projects, sector/industry, venture location, and venture size. The intellectual capital literature has evidenced the positive contribution of intellectual capital on organizational performance (Bontis et al., 2018) as well as on the competitive advantage (Kamukama et al., 2011) generated in value-creating networks (Solitander and Tidström, 2010). Following these insights, IC outcomes' metrics capture the expected outcomes at organisational level (performance measured through sales, revenues, and exports). We complemented the set of metrics by including the potential returns of society associated with the university-industry partnerships' intellectual capital. It is related to the idea that IC impacts competitiveness strongly related to industry spillovers and well-health in society.

3.3. Data analysis

The subsidies have been analysed using diverse econometric models (Dimos and Pugh, 2016: pp. 812-813). Given the complexity of the role of behaviours on intellectual capital dynamics, some authors employed instrumental variables estimations, including the simultaneous equation system (Aerts and Schmidt, 2008; Obeidat et al., 2017). In this regard, this study adopted the structural equation modelling (SEM) to analyse the simultaneous relationships proposed in the conceptual model (Figure 1). This statistical technique has been widely used in behavioural sciences (Shook et al., 2004). This technique allows examining a set of relationships between one or more independent or dependent variables, either continuous or discrete (Tabachnick and Fidell, 1996). Also, this technique allows seeing the weight of each variable, and therefore the direct and indirect contribution, to explain the relationship among the constructs and testing potential mediation effects (Fox, 1980; Sobel, 1982; Cheung and Lau, 2008). We did the reliability and validity tests (see appendixes A1 and A2). The test showed acceptable parameters between 0.6 and 0.7. Additionally, we tested the correlation between constructs. Our conceptual model was tested using the entire sample (Model I) and splitting the sample by opportunistic behaviours (Model IIa) and by collaborative behaviours (Model IIb).

4. FINDINGS

Table III shows the IC dynamic results. All models showed good fits (Shook et al., 2004): the Chi-square (2.50), the GFI (0.89), the CFI (0.87), and RSEA (0.50).

Concerning the influence of behaviours on the positive influence of intellectual capital inputs and intellectual capital outputs (IC inputs→ IC outputs), Model I showed the positive contribution of intellectual capital inputs on intellectual capital outputs [0.725; $p<0.001$]. These results support H1a. It means that the shared experiences, capabilities, and competencies among subsidised university-industry partners have been successfully converted into innovations and technologies. Our results showed that incorporating trained employees generates the highest contribution t0 [8.466; $p<0.100$] in developing innovative/technological outputs followed by scientific partners capabilities t_0 [1.907; $p<0.001$]. Model II also showed that both opportunistic behaviours [0.744; $p<0.001$] and collaborative behaviours [0.532; $p<0.001$] reinforced this relationship. These results support H1b.

Concerning the influence of behaviours on the positive influence of intellectual capital outputs and intellectual capital outcomes (IC outputs → IC outcomes), Model I showed the positive effect of intellectual capital outputs on intellectual capital outcomes [1.687; $p<0.001$]. It means that the subsidised university-industry partners' innovations in new products t_n-t_0 [10.731; $p<0.001$] and new services t_n-t_0 [2.954; $p<0.001$] have created significant value for partners [1.742; $p<0.001$] and society [11.586; $p<0.001$]. These result support H1a. Model II also showed that both opportunistic behaviours [1.470; $p<0.100$] and collaborative behaviours [1.131; $p<0.100$] reinforced this relationship. In the case of opportunistic partners, the generation of new products [15.452; $p<0.001$] has generated the highest contributions via sales [2.338; $p<0.001$] and revenues [1.908; $p<0.001$]. In the case of collaborative partners, the generation of new patents [1.573; $p<0.001$] and dissertations [2.218; $p<0.001$] have generated the highest contributions for partners' performance. It means that opportunistic ventures (model IIb) have the highest effect on sales, revenues, and exports than collaborative ventures (model IIa). In terms of social and economic returns, the results also showed the highest contribution of collaborative behaviours on job creation [14.446; $p<0.001$] than opportunistic behaviours [6.253 $p<0.100$]. Moreover, the spillover effect in terms of an externality that creates more intensity/diversified sectors is generated by opportunistic behaviours [1.22; $p<0.050$]. These results support H2b.

--- Insert Table III ----

Table IV shows the mediation effects. As a robustness test, this mediation test helped to show the patterns observed when tested H1a and H2b. Concerning the specifications, the models showed a good fit according to the established patterns (Shook et al., 2004): the Chi-square (2.50), the GFI (0.89), the CFI (0.87), and RSEA (0.50).

Concerning the influence of behaviours on the mediation role of intellectual capital inputs on intellectual capital outcomes (IC inputs→ IC outputs → IC outcomes), Model I showed a similar positive direct effect [0.651; p<0.05] and indirect effect [0.615; p<0.05] of intellectual capital inputs on intellectual capital outcomes. These results support H3a. It represents the contribution of innovations and technologies developed by the university-industry partnership. Model II also showed the direct effect of opportunistic behaviours [0.682; p<0.050] and collaborative behaviours [0.518; p<0.100]. In this regard, both types of behaviours reinforce the contribution and mediation effect of IC outputs. However, the indirect impact of IC inputs generate on IC outcomes through IC outputs is higher for opportunistic behaviours [0.434; p<0.050] than collaborative ones [0.125; p<0.100]. It means that new products generated by opportunistic behaviour [6.229; p<0.100] have indirectly impacted sales [0.755; p<0.001] and job creation [2.381; p<0.001]. Indeed, the new products generated by collaborative behaviours [3.928; p<0.100] have indirectly impacted sales [0.601; p<0.001] and job creation [9.055; p<0.001]. These results support H3b.

--- Insert Table IV ----

5. DISCUSSION

Our results support the positive influence of behaviours on IC inputs and IC outputs. Concretely, we observe that, while opportunistic behaviours that take advantage through the appropriation of external resources and capabilities in the development of innovations/technologies (Fölster, 1995; Conner and Prahalad, 1996; Chen et al., 2002; Dimos and Pugh, 2016), collaborative behaviours shared their investment and trained employees that combined with scientific partner's capabilities and subsidies development multiple innovations/technologies. In this view, collaborative behaviours allow scaling projects and capture value-added within venture-university partnerships (Buisseret et al., 1995; Lerner, 1999; Clarysse et al., 2009; Dimos and Pugh, 2016).

Results support our assumption about the positive influence of IC outputs on IC outcomes. Particularly, collaborative behaviours have generated the highest socio-economic returns through job creation. Similar to previous studies, collaborative behaviours are positively influenced by initial goals and the expected returns to society (Hill, 1990; Bogers, 2011; Salmi, 2012). Also, opportunistic behaviours generated the highest spillover impacts. A plausible explanation is that they exploit the opportunities via subsidised university-industry projects (Acs et al., 2009). However, opportunistic behaviours generate positive IC outcomes in the short-term. Any reduction of subsidies or external funds could affect projects' sustainability (Söderblom and Samuelsson, 2013). Opportunistic behaviours are motivated by creating value without thinking about returns to society (Sutz, 2000; Klerkx and Aarts, 2013; Hottenrott and Lopes-Bento, 2016).

Our results support our arguments about the mediation role of intellectual capital inputs. Directly and indirectly, the Mexican subsidies have positive and significant impacts on intellectual capital outputs and intellectual capital outcomes (Dimos and Pugh, 2016). The study provides several insights about the IC dynamics (IC inputs→ IC outputs → IC outcomes) within the R&D process of subsided university-industry partnerships. In this sense, our study contributes to the IC literature by evidencing the relationship between IC and innovation (Ponzi, 2002; Manzari et al., 2012; Cuozzo et al., 2017), as well as the positive effects of IC dynamics on performance and competitiveness (Solitander and Tidström, 2010; Kamukama et al., 2011; Bontis et al., 2018).

6. CONCLUSIONS

6.1. Conclusions

This paper analysed how collaborative and opportunistic behaviours within industry-university partnerships influence the subsidised projects' intellectual capital dynamics (IC inputs→ IC outputs → IC outcomes). We tested our proposed model with a sample of 683 Mexican subsidised industry-university partnerships from 2009 to 2016. Three main conclusions emerge from our results. First, the effect of intellectual capital inputs (trained employees' capacities and scientific partner's capabilities) on intellectual capital outputs (innovation and technology transfer) is reinforced by collaborative behaviours within subsidised industry-university partnerships. We extended the academic debate about how public programmes through collaborative industry-university partnerships can stimulate intellectual capital dynamics in emerging economies (Roos and Ross, 1997; Das et al., 2003; Hall et al., 2016; Kianto et al., 2017; Guerrero et al., 2019a, 2019b), as well as the role of intellectual capital dynamics in innovation processes (Ponzi, 2002; Manzari et al., 2012; Cuozzo et al., 2017; Dabić et al., 2021). *Second,* opportunistic behaviours showed a stronger influence on intellectual capital outcomes than collaborative behaviours. Opportunistic partners focused on exploiting external resources (private and public) for generating higher performance (sales, revenues, exports) but with lower socio-economic return (lower rate of new employment). We extended the academic debate about the "dark side" of partnerships stimulated by public programmes in emerging economies by highlighting how opportunistic partners capture benefits of subsidies without generating any societal returns (Chen, 2004; Chen et al., 2014; Dimos and Pugh, 2016; Xie et al., 2016). *Third,* intellectual capital outputs exert a mediation effect in the relationship between inputs and outcomes. It means that, directly or indirectly, the initial inputs of subsidised projects generate the expected returns that pursued the incentive programme. In this vein, although we are not evaluating the effectiveness of subsidies, our insights contribute to the debate about the effectiveness of subsidies on private/collaborative intellectual capital activities/outcomes (Dimos and Pugh, 2016; Greco et al., 2016; Hall et al., 2016; Obeidat et al., 2017; Pedro et al., 2018).

6.2. Limitations and future research agenda

This research has some limitations that provide a future research agenda. *The first limitation* is associated with the academics' criticisms related to the "unconventional" IC definition and metrics. This research represents an experiment that translates into intellectual capital dynamics reasoning. A proposed conceptual approach (and metrics) shows the flow or conversion of the intangible components (and behaviours) related to science-industry cooperation into IC inputs and outputs, and outcomes will impact performance. This study adopted a general definition of IC, indicates that it is related to "intangible" (e.g., Wyatt, 2008; Serrat, 2017; Ullberg et al., 2021) that are very complex and difficult to measure (Dumay, 2009). Within university-industry relationships, the proposed proxies of IC inputs represent the knowledge and know-how that can be used to achieve the collaboration goals and how these IC inputs experiment a dynamic process of conversion into outputs and outcomes. Future research should question our proposed metrics, as well as if the traditional way to measure IC should also be discussed and updated. *The second limitation* is associated with our dataset. We recognize the difficulty of matching with non-subsidised partnerships to contrast our results by the lack of information. We tried to solve this problem by exploring this match using multiple case studies of subsidised partnerships (focus group) and non-subsidised partnerships (control group). The natural extension extends the analysis about the effectiveness or contribution of subsidies in the dynamics of intellectual capital and explores the outcomes obtained by subsidised vs. non-subsidised partnerships (Guerrero and Urbano, 2019a). *The third limitation* is related to collaborative/opportunistic behaviours and intellectual capital dynamism (inputs/outputs/outcomes). Our study followed the criterion to identify collaborative/opportunistic behaviours by using differences between the planned vs. real investments per partner. We believe that opportunistic/collaborative behaviours and intellectual capital dynamic measures are very complex. Our future research agenda includes new metrics that help us capture collaborative/opportunistic behaviours within subsidised projects or any innovation partnership (Gianiodis et al., 2016), and the intellectual capital dynamic metrics (Manzari et al., 2012; Cuozzo et al., 2017). Future studies should also explore the implementation of mixed measures (objective and subjective) to understand better the influence of behaviours on the contribution of intellectual capital inputs on partnerships' outcomes. It also implies extending the analysis of control mechanisms by combining knowledge management and innovation (Del Giudice and Maggioni, 2014; Bornemann et al., 2021; Pawlowsky et al., 2021). *The four limitation* is related to the unit of analysis. Our dataset included subsidised projects of industry-university partnerships. However, the programme requirements demanded that the industry partner submitted the proposal. It explains why we controlled by the partnership and industrial partner characteristics. In future research, industrial partners and research partners should be analysed to understand better their involvement in intellectual capital dynamics, subsidies, and behaviours (Chen et al., 2020). A balance between theory and practice should be considered in future studies. The lack of studies about dynamics and relationships among collaboration partnerships demands longitudinal analyses and robust conceptual approaches (evolutionary, contingency, or ambidexterity). The *fifth limitation* is related to contextual conditions. In emerging economies, the quality of institutions generates negative externalities (i.e., corruption, bribes). Almost 30% of the subsidised partnerships were located in cities with higher corruption levels (Guerrero and Urbano, 2020). The location could influence the submission/selection process of grants, incentives, and subsidies. Future research should control by geographical dispersion and co-location of subsidies (Kafouros et al., 2018; Urbano et al., 2019). The lack of studies demands new conceptual frameworks to explore uncertain scenarios characterized by multiple institutional voids. *Finally*, intellectual capital literature also demands an update and review of the accumulated literature. It is hard to understand the absence of unique definitions that help to conduct and replicate research across levels of analysis and contexts (Manzari et al., 2012). Indeed, given the unexpected external events (e.g., COVID-19 pandemic), future research should also consider the digitalisation into the relationship between IC intellectual and value co-creation process with other collectives like students (Magni et al., 2020, 2021), technology transfer from academics (Siegel and Guerrero, 2021), government (Johanson et al., 2006), ecosystem agents (Guerrero et al., 2020), supply chain (Mubarik et al., 2021); final users (Rossi and Magni, 2017), non-profit organisations (Blankenburg et al., 2018) and civil society

6.3. Implications

Several implications emerge from our study for stakeholders (policymakers, enterprise managers, and university managers) involved in the Mexican innovation and entrepreneurship ecosystems. *For policymakers*, the study provides insights into the effectiveness of IC dynamics, behaviours and subsidies. The bright side allows evaluating the cost-benefit of this government intervention and the effects on priority industries. On the dark side, as a part of the protectionist strategies, the current Mexican administration does not continue with substantial investments to reinforce intellectual capital within industry-university partnerships like previous administrations. Our results allow policymakers to understand the challenges and impacts of re-defining/re-incentivizing the different value-chain actors (Dussel et al., 2018; Takalo and Tanayama, 2010). Ex-post funding provides a strong incentive to produce measurable outputs (e.g., subsidised partnerships should be monitored). Ex-ante mechanisms could also help to control what (projects), who (behaviours), which (intellectual capital), why (expected outcomes) need to be subsided (Manzari et al., 2012; Guerrero et al., 2019a). *For enterprise managers*, this study offers IC dynamics and behaviours within subsidised industry-university partnerships. The bright side of collaboration behaviours is related to the positive impacts on intellectual capital performance and socio-economic returns. It opens the transformation of intellectual capital strategies oriented to the diversification into new sectors (i.e., knowledge, information, intellectual property, human capital experience, and relational) to create value-added (Kianto et al., 2017; Bosio et al., 2018). The dark side is the appropriation behaviours of partners. In this view, to capture the intellectual capital value in the long-term, the results provide insights into the relevance of a shared vision/goals and the trust for reducing opportunistic behaviours within partnerships (Söderblom and Samuelsson, 2013). *For the university community*, industry-university partnerships are useful for the innovative transformation process of universities. In this sense, open collaboration practices with diverse agents involved in the entrepreneurial and innovative ecosystem will be an excellent strategy to reinforce their core activities and develop intellectual capital capabilities in the region (Guerrero and Urbano, 2016; Guerrero et al., 2019a,b). The outcomes are also relevant to legitimize their role in society and their contribution to regional development.

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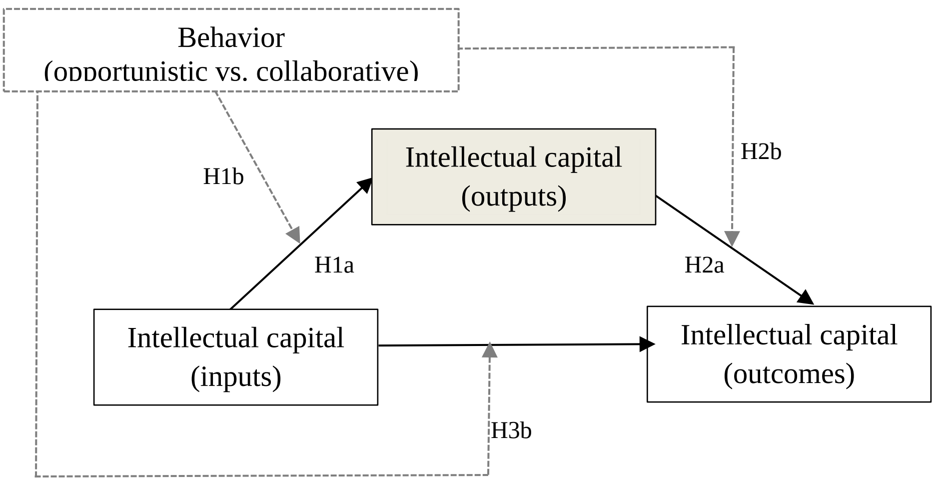
Figure 1: Conceptual model



H3a

Note: Direct effects ; Mediation effect ; Moderation effect

Source: Authors

Table I. Number of supported and non-supported applications to the Incentive Programme for Innovation, 2009-2014

Year	INNOVAPYME		INNOVATEC		PROINNOVA	
	Supported	**Non-supported**	**Supported**	**Non-supported**	**Supported**	**Non-supported**
2009	177	652	279	876	47	92
2010	257	602	229	316	191	699
2011	207	575	112	568	224	595
2012	152	474	126	362	244	613
2013	198	543	146	286	362	582
2014	241	608	169	236	456	772
Total	**1232**	**3454**	**1061**	**2644**	**1524**	**3353**

Source: CONACYT

Table II: Variables

Construct	Sub-construct	Variable	Measure	Theoretical support
Behaviors	Opportunistic vs. Collaborative behavior t_0		Binary: (1) Opportunistic when the subsidized partners contribute with less than the total amount that was indicated in the submitted proposal. (0) Collaborative behavior when the when the subsidized partners financed the total amount indicated in the initial proposal.	Clarysse et al., 2009; Söderblom et al. 2015; Dimos and Pugh, 2016
Intellectual capital (inputs)	Capabilities	Scientific partners t_0	Number of collaborations with universities and research centers enrolled in subsided projects indicated in the initial proposal	Belderbos et al., 2004; García-Quevedo, 2004; Busom and Fernandez Ribas, 2008; Unger et al., 2011; Schwartz et al., 2012; Guerrero et al., 2019b; Bellini et al., 2019;
		Commercial partners t_0	Number of collaborations with other firms enrolled in the subsided projects indicated in the initial proposal	
	Competences	Trained employees t_0	Number of trained employees of the venture indicated in the initial proposal	
	Experience	R&D experience – scale	Number of subsided projects	
		R&D experience – time	Number of years enrolled in the subsided projects	
Intellectual capital (outputs)	Innovation outputs	New products t_n-t_0	Number of new products obtained at the end respect to the expected products indicated in the initial proposal	Buisseret et al., 1995; Belderbos et al., 2004; García-Quevedo, 2004; Falk, 2007; Aerts and Schmidt, 2008; Busom and Fernandez Ribas, 2008; Clarysse et al., 2009; Guerrero et al., 2019b
		New services t_n-t_0	Number of new services obtained at the end respect to the expected services indicated in the initial proposal	
		New processes t_n-t_0	Number of new processes obtained at the end respect to the expected processes indicated in the initial proposal	
	Technology transfer outputs	New patents t_n-t_0	Number of new patents obtained at the end respect to the expected patents indicated in the initial proposal	
		New utility models t_n-t_0	Number of new utility models obtained at the end respect to the expected utility models indicated in the initial proposal	
		New dissertations t_n-t_0	Number of new dissertations obtained at the end respect to the expected dissertations indicated in the initial proposal	
Intellectual capital (outcomes)	Performance	LnSales t_n-t_0	Natural logarithm of sales generated at the end respect to the expected sales indicated in the initial proposal	García-Quevedo, 2004; Söderblom et al., 2015; Dimos and Pugh, 2016; Hottenrott and Lopes-Bento, 2016; Bellucci et al., 2018
		LnRevenue t_n-t_0	Natural logarithm of revenues generated at the end respect to the expected revenue indicated in the initial proposal	
		LnExports t_n-t_0	Natural logarithm of exports generated at the end respect to the expected exports indicated in the initial proposal	
	Return to society	Spillovers t_n-t_0	Number of new projects in diversified sectors respect to the sector indicated in the initial proposal	
		Employment t_n-t_0	Number of new employment generated at the end respect to the expected new employment indicated in the initial proposal	
Control		Sector/Industry, venture location, number of projects, venture size, investment per partner		

Table III: SEM regression weights [General test]

	Relationships			All sample (Model I)			Collaborative behavior (Model IIa)			Opportunistic behavior (Model IIb)		
				Coef.	S.E.	P	Coef.	S.E.	P	Coef.	S.E.	P
H1a	Intellectual capital outputs	<---	Intellectual capital inputs	0.725	0.139	***	0.532	0.122	***	0.744	0.196	***
H2a	Intellectual capital outcomes	<---	Intellectual capital outputs	1.687	0.401	***	1.131	0.376	*	1.470	0.543	*
Intellectual capital (inputs)	R&D experience – scale	<---	Intellectual capital inputs	0.694	0.049	***	0.614	0.067	***	0.537	0.053	***
	R&D experience – time	<---	Intellectual capital inputs	1.365	0.122	***	0.890	0.171	***	1.220	0.128	***
	Scientific partners t_0	<---	Intellectual capital inputs	1.907	0.470	***	1.070	0.557	*	1.779	0.239	***
	Commercial partners t_0	<---	Intellectual capital inputs	1.082	0.610	*	-0.194	1.118		1.724	0.303	***
	Trained employees t_0	<---	Intellectual capital inputs	8.466	3.271	*	8.233	4.104	*	7.339	2.923	**
Intellectual capital (outputs)	New products t_n-t_0	<---	Intellectual capital outputs	10.731	2.575	***	5.727	1.644	***	15.452	5.026	**
	New services t_n-t_0	<---	Intellectual capital outputs	2.954	0.659	***	2.394	0.658	***	2.631	0.916	**
	New processes t_n-t_0	<---	Intellectual capital outputs	0.749	0.404	*	0.253	0.562		0.917	0.337	**
	New patents t_n-t_0	<---	Intellectual capital outputs	1.598	0.381	***	1.573	0.521	**	1.213	0.271	***
	New utility models t_n-t_0	<---	Intellectual capital outputs	1.626	0.149	***	1.636	0.210	**	1.825	0.184	***
	New dissertations t_n-t_0	<---	Intellectual capital outputs	0.912	0.230	***	2.218	0.585	***	0.312	0.137	*
Intellectual capital (outcomes)	LnSales t_n-t_0	<---	Intellectual capital outcomes	1.348	0.161	***	1.101	0.215	***	2.338	0.555	***
	LnRevenue t_n-t_0	<---	Intellectual capital outcomes	1.742	0.089	***	1.428	0.102	***	1.908	0.177	***
	LnExports t_n-t_0	<---	Intellectual capital outcomes	1.121	0.164	***	0.986	0.303	**	1.314	0.282	***
	Spillovers t_n-t_0	<---	Intellectual capital outcomes	0.048	0.015	**	0.028	0.018		0.122	0.047	**
	Employment t_n-t_0	<---	Intellectual capital outcomes	11.586	2.053	***	14.446	3.899	***	6.253	2.457	*

[Standardized estimates; CMIN/DF 2.50; GFI 0.889; CFI 0.872; RSEA 0.051]
Level of statistical significance: *** $p \leq 0.001$, ** $p \leq 0.05$, * $p \leq 0.10$.

Table IV: SEM regression weights [Mediation test]

	Relationships			All sample (Model I)			Collaborative (Model IIa)			Opportunistic (Model IIb)		
				Coef.	S.E.	P	Coef.	S.E.	P	Coef.	S.E.	P
H1a	Intellectual capital outputs	<---	Intellectual capital inputs	0.704	0.136	***	0.461	0.117	***	0.706	0.194	***
H2a	Intellectual capital outcomes	<---	Intellectual capital outputs	0.875	0.344	**	0.272	0.043	*	0.614	0.238	*
H3a	Intellectual capital outcomes	<---	Intellectual capital inputs	0.651	0.258	**	0.518	0.235	*	0.682	0.245	**
Intellectual capital (inputs)	Experience – scale	<---	Intellectual capital inputs	0.694	0.049	***	0.630	0.067	***	0.538	0.053	***
	Experience – time	<---	Intellectual capital inputs	1.366	0.122	***	0.940	0.172	***	1.221	0.128	***
	Scientific partners t_0	<---	Intellectual capital inputs	1.914	0.469	***	1.133	0.566	*	1.774	0.239	***
	Commercial partners t_0	<---	Intellectual capital inputs	1.082	0.608	*	-0.134	1.132		1.719	0.303	***
	Trained employees t_0	<---	Intellectual capital inputs	8.705	3.265	**	8.098	4.002	*	7.461	2.923	*
Intellectual capital (outputs)	New products t_n-t_0	<---	Intellectual capital outputs	10.416	2.479	***	5.564	1.500	***	13.667	5.085	**
	New services t_n-t_0	<---	Intellectual capital outputs	3.035	0.660	***	2.457	0.639	***	2.666	0.980	**
	New processes t_n-t_0	<---	Intellectual capital outputs	0.719	0.400	*	0.230	0.566		0.869	0.352	*
	New patents t_n-t_0	<---	Intellectual capital outputs	1.533	0.364	***	1.323	0.448	**	1.412	0.331	***
	New utility models t_n-t_0	<---	Intellectual capital outputs	1.000	0.155	***	1.000	0.256	**	1.000	0.166	***
	New dissertations t_n-t_0	<---	Intellectual capital outputs	0.878	0.221	***	2.603	0.724	***	0.236	0.118	**
Intellectual capital (outcomes)	LnSales t_n-t_0	<---	Intellectual capital outcomes	1.329	0.161	***	0.978	0.195	***	2.773	0.902	**
	LnRevenue t_n-t_0	<---	Intellectual capital outcomes	1.752	0.091	***	1.022	0.204	***	1.691	0.117	**
	LnExports t_n-t_0	<---	Intellectual capital outcomes	1.113	0.165	***	1.191	0.249	***	1.271	0.493	*
	Spillovers t_n-t_0	<---	Intellectual capital outcomes	0.052	0.015	***	0.030	0.015	*	0.203	0.091	*
	Employment t_n-t_0	<---	Intellectual capital outcomes	11.896	2.105	***	14.740	3.763	***	8.744	3.126	*

The direct and indirect effect

H	Relationships	Model I Entire Sample		Model II. Behavior			
				Collaborative		Opportunistic	
		Direct	Indirect	Direct	Indirect	Direct	Indirect
H1b	Intellectual capital inputs → Intellectual capital outputs	0.704 ***		0.461 ***		0.706 ***	
H2b	Intellectual capital outputs → Intellectual capital outcomes	0.875 **		0.272 *		0.614 *	
H3b	Intellectual capital inputs → Intellectual capital outputs → Intellectual capital outcomes	0.651 **	0.616 **	0.518 *	0.125 *	0.682 **	0.434 **

[Standardized estimates; CMIN/DF 2.50; GFI 0.891; CFI 0.874; RSEA 0.051]
Level of statistical significance: *** $p \leq 0.001$, ** $p \leq 0.05$, * $p \leq 0.10$.

Appendix A1: Correlation Matrix

No.	Variable	Mean	Std. Deviation	1	2	3	4	5	6	7	8	9	10
1	Behavior	.592	.492	1.000									
2	New products t_n-t_0	8.996	32.820	-.027	1.000								
3	New services t_n-t_0	3.764	7.567	-.067*	.162***	1.000							
4	New processes t_n-t_0	1.690	6.976	-.066*	.136***	.128***	1.000						
5	New patents t_n-t_0	1.146	5.399	-.047	.023	.134***	.009	1.000					
6	New utility models t_n-t_0	.735	3.402	-.029	.100*	.147***	.021	.158***	1.000				
7	New dissertations t_n-t_0	1.243	3.101	.064*	.073*	.087*	.013	.114*	.053	1.000			
8	LnExp expenditure-venture t_0	15.710	1.212	-.484***	.153***	.213***	.088*	.094*	.147***	.116***	1.000		
9	LnExp expenditure-partners t_0	16.022	.956	.125***	.147***	.214***	.047	.087*	.150***	.205***	.682***	1.000	
10	LnExp expenditure-subsidies t_0	12.428	4.219	.315***	.054	.099*	.014	.088*	.071*	.138***	-.040	.411***	1.000
11	Experience – scale	2.555	1.090	-.017	.204***	.226***	.119***	.123***	.116***	.228***	.406***	.496***	.262***
12	Experience – time	3.489	2.686	-.145***	.208***	.273***	.163***	.178***	.134***	.265***	.399***	.364***	.120***
13	Scientific partners t_0	2.862	10.224	-.047	.140***	.070*	.016	.034	.025	.076*	.169***	.133***	-.031
14	Commercial partners t_0	2.053	13.307	-.032	.065*	.050	.008	.031	.091*	.042	.059	.050	.034
15	Trained employees t_0	18.940	71.613	-.082*	.051	.039	.032	.079*	.046	.008	.191***	.079*	-.061
16	LnSales t_n-t_0	3.260	5.790	-.168***	.193***	.085*	.064*	.091*	.130***	.145***	.267***	.165***	.009
17	LnRevenues t_n-t_0	2.542	5.060	-.152***	.132***	.065*	.046	.034	.068*	.106***	.228***	.143***	.024
18	LnExport t_n-t_0	1.615	4.460	-.172***	.149***	.138***	.023	.152***	.109*	.070*	.282***	.179***	.011
19	Spillovers t_n-t_0	.309	.462	.001	-.018	.016	.009	.024	.020	.015	.117***	.181***	.135***
20	Employment t_n-t_0	16.984	39.830	-.181***	.111*	.084*	.026	.250***	.091*	.019	.358***	.279***	.083*

No.	Variable	Mean	Std. Deviation	11	12	13	14	15	16	17	18	19	20
11	Experience – scale	2.555	1.090	1.000									
12	Experience – time	3.489	2.686	.641***	1.000								
13	Scientific partners t_0	2.862	10.224	.143***	.362***	1.000							
14	Commercial partners t_0	2.053	13.307	.083*	.149***	.079*	1.000						
15	Trained employees t_0	18.940	71.613	.078*	.091*	.056	.000	1.000					
16	LnSales t_n-t_0	3.260	5.790	.229***	.188***	.069*	.068*	.066*	1.000				
17	LnRevenues t_n-t_0	2.542	5.060	.170***	.118***	.062	.046	.101***	.641***	1.000			
18	LnExport t_n-t_0	1.615	4.460	.192***	.181***	.096*	.027	.044	.490***	.429***	1.000		
19	Spillovers t_n-t_0	.309	.462	.212***	.184***	.001	-.015	-.026	.053	.021	.103*	1.000	
20	Employment t_n-t_0	16.984	39.830	.275***	.180***	.101*	.011	.330***	.212***	.225***	.243***	.053	1.000

Appendix A2: Reliability and validity analysis

Construct	Variable	Internal validity	Confirmatory factor analysis	Reliability: Alpha Cronbach
Intellectual capital (inputs)	Scientific partners t_0	0.643	KMO = 0.670 Chi2 =1489.15	0.657
	Commercial partners t_0	0.691		
	Trained employees t_0	0.533		
	R&D experience – scale	0.427		
	R&D experience – time	0.509		
Intellectual capital (outputs)	New products t_n-t_0	0.463	KMO = 0.601 Chi2 =99.269	0.601
	New services t_n-t_0	0.429		
	New processes t_n-t_0	0.543		
	New patents t_n-t_0	0.529		
	New utility models t_n-t_0	0.370		
	New dissertations t_n-t_0	0.235		
Intellectual capital (outcomes)	LnSales t_n-t_0	0.727	KMO = 0.692 Chi2 =631.248	0.621
	LnRevenue t_n-t_0	0.701		
	LnExports t_n-t_0	0.569		
	Spillovers t_n-t_0	0.955		
	Employment t_n-t_0	0.238		